

## **REMARKS**

### **I. Introductory Comments**

Claims 1, 4-42 and 45 are pending in the Subject Application. Claims 4, 6-18, 24-27, 30-32 and 35-42 were subject to a restriction requirement and have been withdrawn. Claim 45 has been canceled. Claims 46-49 are added herein.

Claims 1, 5, 19-23, 28, 33, 34, and 45 stand rejected under 35 U.S.C. § 112, first paragraph, as allegedly failing to comply with the enablement requirement.

Claims 1, 5, 19-23, 28, 33, 34, and 45 stand rejected under 35 U.S.C. § 102(b) or (e) as allegedly being anticipated by U.S. Patent No. 5,984,997 to Bickmore et al. ("Bickmore").

Claims 19 and 20 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 6,156,428 to Gibson et al. ("Gibson").

Claims 1, 5, 19-23, 28, 33, 34, 45 stand rejected under 35 U.S.C. § 102(b) or (e) as allegedly being anticipated by U.S. Patent No. 6,344,271 ("US '271").

Applicant respectfully traverses each of these rejections for at least the reasons set forth herein. In view of the above amendments and the following remarks, Applicant respectfully requests reconsideration and withdrawal of the rejections and allowance of the pending claims.

### **II. Amendments to the Specification**

The specification has been amended to correct priority to provisional application No. 60/110,442 filed Dec. 1, 1998. In the Office Action mailed on April 17, 2008, on pages 6-7, the examiner queried U.S. provisional applications 60/111,442 and 60/069,936 and stated that "None of them has anything to do with the present claimed subject matter." Applicant respectfully directs the examiner's attention to Applicant's response mailed on July 17, 2008 which amended the specification to correct priority to U.S. provisional application No. 60/069,935 filed December 17, 1997 and deleted reference to U.S. provisional application Nos. 60/069,936 and 60/111,442.

Applicant respectfully submits that the Subject Application claims priority to provisional application No. 60/110,442 filed Dec. 1, 1998. The Subject Application

claims the benefit of U.S. application 10/150,722, now U.S. Patent 6,602,595, which also claims the benefit of provisional application No. 60/110,442.

### III. Claim Amendments

#### A. Amendments

Claim 45 has been canceled.

Claims 1, 19, and 33 have been amended to clarify that the nanomaterial may be transformed to non-stoichiometric after formation. Support for this language is found throughout the Subject Application, such as, for example, paragraph [0146] and Examples 1 and 19. Accordingly, no new matter is added by this amendment.

#### B. New Claims

Claim 46 has been added to further recite that the nanomaterial may be transformed to non-stoichiometric after formation by at least one of heating in a reducing atmosphere, heating in inert atmosphere, heating in oxidizing atmosphere, solvent extraction, electrochemical transformation, electromagnetic field treatment, ion beam treatment, electron beam treatment, photonic treatment, rapid quench, plasma treatment, nuclear radiation, supercritical phase treatment, biological treatment, or a combination thereof. Support for this language is found throughout the Subject Application, such as, for example, paragraphs [0146] and Examples 19 and 20. Accordingly, no new matter is added by this amendment.

Claim 47 has been added to further recite that the nanomaterial may be transformed to non-stoichiometric after formation by at least one of heating in a reducing atmosphere, heating in inert atmosphere, heating in oxidizing atmosphere, solvent extraction, electrochemical transformation, electromagnetic field treatment, ion beam treatment, electron beam treatment, photonic treatment, rapid quench, plasma treatment, nuclear radiation, supercritical phase treatment, biological treatment, or a combination thereof. Support for this language is found throughout the Subject Application, such as, for example, paragraphs [0146] and Examples 19 and 20. Accordingly, no new matter is added by this amendment.

Claims 48 and 49 have been added to further recite that the non-stoichiometric nanomaterial may have the formula  $M_{n/p}Z_{1-x}$  wherein M can be any element that can lower its free energy by chemically bonding with Z, wherein Z is a chalcogenide, wherein n and p are integers greater than or equal to 1, and wherein  $0.01 < x < 0.99$ , and wherein the nanomaterial has an aspect ratio greater than 5 and less than or equal to 25. Support for this language is found throughout the Subject Application, such as, for example, original claim 1, and paragraphs [0082]-[0088] and [0119]. Accordingly, no new matter is added by this amendment.

The present amendments are made without prejudice or disclaimer to the subject matter of the claims as originally filed. Furthermore, Applicant does not acquiesce or otherwise concede the correctness of the rejections to the previously presented claims. Accordingly, Applicant hereby reserves the right to pursue the subject matter of the claims as previously presented or as originally filed in the Subject Application in related applications that may be currently on file or filed at a later date. Moreover, Applicant hereby reserves the right to submit in such related applications arguments made in connection with the Subject Application. The amendments presented herein are solely made to expedite the prosecution of the Subject Application.

#### IV. Double Patenting Rejections

Applicant requests that the various non-statutory double patenting issues be stayed pending final disposition of the claims in the Subject Application with respect to the statutory rejections under 35 U.S.C. § 103 addressed herein. Thereafter, the non-statutory double patenting issues - specifically the issue of whether it is necessary to file a terminal disclaimer - can be addressed in view of the otherwise allowable subject matter and its relation, if any, to the subject matter claimed in U.S. Patent No. 6,344,271.

#### V. Claim Rejections under 35 U.S.C. §112, first paragraph

Claims 1, 5, 19-23, 28, 33, 34, and 45 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. Please refer to pages

2-4 of the Office Action for the complete reasons for rejection. "The test of enablement is whether one reasonably skilled in the art could make or use the invention from the disclosures in the patent coupled with information known in the art without undue experimentation." MPEP § 2164 citing *United States v. Telectronics, Inc.*, 857 F.2d 778, 785, 8 USPQ2d 1217, 1223 (Fed. Cir. 1988). In view of the above amendments and the following remarks, Applicant respectfully requests reconsideration and withdrawal of the rejections and allowance of the pending claims.

A. Claim 45

Claim 45 has been canceled. Accordingly, Applicant respectfully submits that this rejection is obviated.

B. Claims 19 and 20

Applicant respectfully submits that the claims 19 and 20 are fully enabled by the specification as originally filed. Applicant respectfully directs the examiner to paragraph [0119] of the Subject Application, where it is noted that "The multimetallic powders may also comprise nanowhiskers and/or nanorods, with aspect ratios in a range of 1-25," and paragraph [0121] of the Subject Application, where it is noted that "Whiskers may be round or faceted...." Applicant also respectfully directs the examiner to Example 8 of the Subject Application, where it is noted that "The experiment also produced WO<sub>3</sub> nanowhiskers and nanorods with aspect ratios ranging from 5 to 15." Applicant respectfully submits that the Subject Application specifically describes methods of producing non-stoichiometric materials in at least paragraphs [0146]-[0149] of the Subject Application. Applicant respectfully submits that one reasonably skilled in the art could make the nanomaterials recited in claims 19 and 20 in view of at least paragraphs [0088], [0119], and [0121] and Example 8 of the Subject Application coupled with information known in the art without undue experimentation. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 19 and 20 under § 112, first paragraph.

C. Claims 1, 5, 21-23, 28, 33, and 34

Applicant respectfully submits that claims 1, 5, 21-23, 28, 33, and 34 are fully enabled by the specification as originally filed. The specification clearly provides support for various embodiments that teach the nanomaterials recited in claims 1 and 33. On page 4 of the Office Action, the examiner characterizes Bickmore as a 35 U.S.C. §§ 102(b) or (e) reference as follows:

5.1. Bickmore teaches a method of making nanowhiskers and/or nanorods of chalcogenides with aspect ratios in a range of 1-25 (see col. 2, lines 20-29 and 65-67). The nanomaterials include non-stoichiometric chalcogenides (col. 2, lines 30-37). S-, Se-, and Te-containing chalcogenides are suggested at col. 3, lines 65-67 and col. 6, lines 23-31.

Applicant respectfully directs the examiner's attention to paragraph [0113] of the Subject Application that incorporates Bickmore by reference and paragraph [0114] of the Subject Application that recites Bickmore. "As long as the specification discloses at least one method of making and using the claimed invention that bears a reasonable correlation to the entire scope of the claim, then the enablement requirement of 35 U.S.C. § 112 is satisfied." MPEP 2164.01(b). Therefore, Applicant respectfully submits that one reasonably skilled in the art could make the nanomaterials recited in claims 1 and 33 in view of at least paragraphs [0113] and [0114] coupled with information known in the art without undue experimentation. Accordingly, Applicant respectfully requests withdrawal of the rejection of claims 1 and 33 under § 112, first paragraph.

Applicant respectfully submits that the Subject Application also provides extensive detail regarding methods of making the nanomaterials having the aspect ratios recited in claims 1 and 33. Applicant respectfully disagrees with the examiner's assertion that "a method of making polymetallic material having an aspect ratio of up to 25 (paragraphs [0090], [0093], and [0096]), such method is not described to extend to chalcogenides in terms of aspect ratio." Office Action, p. 2. (emphasis added). Applicant respectfully directs the examiner's attention to paragraph [0119] of the Subject Application, where it is noted:

The multimetallic powders include at least two elements selected from the s group, p group, d group, and f group of the periodic table (e.g.,...sulfur...), and may include three or more such elements... The multimetallic powders may also comprise nanowhiskers and/or nanorods, with aspect ratios in a range of 1-25. Subject Application, paragraph [0119]. (emphasis added).

Applicant respectfully submits that the p group of the periodic table includes chalcogenides, i.e., sulfur, selenium, and tellurium. Indeed, paragraph [0119] specifically recites sulfur. Therefore, Applicant respectfully submits that one reasonably skilled in the art could make the nanomaterials recited in claims 1 and 33 by the methods described in at least paragraphs [0090], [0093], and [0096] in view of paragraph [0119] coupled with information known in the art without undue experimentation.

Applicant also respectfully submits that the Subject Application provides representative examples of nanomaterials having the aspect ratios recited in claims 1 and 33. "The specification need not contain an example if the invention is otherwise disclosed in such manner that one skilled in the art will be able to practice it without an undue amount of experimentation." MPEP § 2164.02. Applicant respectfully directs the examiner's attention to Examples 8 and 9 of the Subject Application. Example 8 states that "The experiment also produced WO<sub>3</sub> nanowhiskers and nanorods with aspect ratios ranging from 5 to 15." Subject Application, paragraph [0198]. Example 9 states that "The aspect ratios of the nanowhiskers were in the range of 3-20." Subject Application, paragraph [0200]. Therefore, Applicant respectfully submits that one reasonably skilled in the art could make the nanomaterials recited in claims 1 and 33 by the methods described in at least Examples 8 and 9 in view of paragraph [0119] coupled with information known in the art without undue experimentation.

Applicant respectfully submits that the Subject Application provides extensive detail regarding methods of making the non-stoichiometric nanomaterials recited in claims 1 and 33. Applicant respectfully submits that the Subject Application specifically describes methods of producing non-stoichiometric materials in at least paragraphs [0146]-[0149] of the Subject Application. In particular, paragraph [0146] recites the

following:

Method 1: Start with submicron powders, preferably nanopowders. Transform the powders into a non-stoichiometric form by one or more of the following techniques--heating in inert atmosphere, heating in oxidizing atmosphere, heating in reducing atmosphere, solvent extraction, chemical reaction, electrochemical transformation, electromagnetic field treatment, ion beam treatment, electron beam treatment, photonic treatment, rapid quench, plasma treatment, nuclear radiation, supercritical phase treatment, biological treatment, or a combination of one or more techniques. Utilize the non-stoichiometric material so obtained. It may be desirable to sinter the non-stoichiometric powders into a solid. It may further be desirable to reconvert the non-stoichiometric material to a stoichiometric form.

Therefore, Applicant respectfully submits that one reasonably skilled in the art could make the nanomaterials recited in claims 1 and 33 by the methods described in at least Examples 8 and 9 in view of paragraphs [0119] and [0146]-[0149] coupled with information known in the art without undue experimentation.

Since claims 5, 21-23, 28, and 34 depend, either directly or indirectly, from independent claims 1 and 33, Applicant submits that claims 5, 21-23, 28, and 34 also fully comply with the requirements of 35 U.S.C. § 112, first paragraph. Accordingly, Applicant respectfully requests that the rejection of claims 1, 5, 21-23, 28, 33, and 34 under 35 U.S.C. § 112, first paragraph, be reconsidered and withdrawn.

#### VI. Claim Rejections under 35 U.S.C. §102(b) or (e)

A claim is anticipated under § 102(b) or (e) only if each and every element as set forth in the claim is described, either expressly or inherently, in a single prior art reference, arranged as required by the claim, and in as complete detail as is contained in the claim. See MPEP §2131.

##### A. Bickmore

Claims 1, 5, 19-23, 28, 33, 34, and 45 stand rejected under 35 U.S.C. §§ 102(b) or (e) as anticipated by U.S. Patent No. 5,984,997 to Bickmore et al. ("Bickmore"). Please refer to pages 4-5 of the Office Action for the complete reasons for rejection.

Applicants respectfully submit that this rejection is improper because Bickmore fails to teach each and every element as set forth in independent claims 1, 19 and 33, either expressly or inherently. In view of the foregoing amendments and following remarks, Applicant respectfully traverses this rejection and request that it be reconsidered and withdrawn.

Claim 45 has been canceled. Accordingly, Applicant respectfully submits that this rejection is obviated.

Applicant respectfully submits that Bickmore fails to teach or suggest nanomaterials transformed to non-stoichiometric after formation as recited in independent claims 1, 19, and 33. The Office Action states that "The nanomaterials include non-stoichiometric chalcogenides (col. 2, lines 30-37)." Applicant respectfully submits that Bickmore teaches "a method of continuously producing fine powders of complex inorganic compositions, including...chalcogenides... by combustion of emulsions." Bickmore, col. 2, lines 20-25. (emphasis added). Applicant respectfully submits that Bickmore teaches "...in conjunction with varying combustion conditions, the product chemistry may be varied to obtain non-stoichiometric...materials." Bickmore, col. 2, lines 29-30. (emphasis added). Applicant respectfully submits that Bickmore makes no mention of nanomaterials transformed to non-stoichiometric after formation, i.e., after combustion, as recited in independent claims 1, 19, and 33. Accordingly, Applicant respectfully submits that Bickmore fails to teach or suggest each and every element as set forth in independent claims 1, 19, and 33 and claims 5, 20-23, 28, and 34, which depend, directly or indirectly, from independent claims 1, 19, and 33, respectively, for at least the reasons stated herein.

Furthermore, Applicant respectfully submits that Bickmore fails to teach or suggest nanomaterials as recited in claims 48 and 49 having the formula  $M_{n/p}Z_{1-x}$  wherein M can be any element that can lower its free energy by chemically bonding with Z, Z can be a chalcogenide, wherein n and p can be integers greater than or equal to 1, and wherein  $0.01 < x < 0.99$ . Accordingly, Applicant respectfully submits that Bickmore fails to teach or suggest each and every element as set forth in independent claim 1 and dependent claims 48 and 49 for at least the reasons stated herein.



B. Gibson

Claims 19 and 20 stand rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Patent No. 6,156,428 to Gibson et al. ("Gibson"). Please refer to page 5 of the Office Action for the complete reasons for rejection. Applicants respectfully submit that this rejection is improper because Gibson fails to teach each and every element as set forth in claims 19 and 20, either expressly or inherently. In view of the foregoing amendments and following remarks, Applicant respectfully traverses this rejection and request that it be reconsidered and withdrawn.

Applicant respectfully submits that Bickmore fails to teach or suggest nanomaterials transformed to non-stoichiometric after formation as recited in claims 19 and 20. Accordingly, Applicant respectfully submits that Gibson fails to teach or suggest each and every element as set forth in claims 19 and 20 for at least the reasons stated herein.

C. US '271

Claims 1, 5, 19-23, 28, 33, 34, 45 stand rejected under 35 U.S.C. § 102(b) or (e) as anticipated by U.S. Patent No. 6,344,271 ("US '271"). Please refer to page 5 of the Office Action for the complete reasons for rejection. In view of the foregoing amendments and following remarks, Applicant respectfully traverses this rejection and request that it be reconsidered and withdrawn.

Applicant respectfully submits the US '271 is not a proper reference under §§ 102(b) or (e). Applicant respectfully disagrees with the examiner's assertion that the Subject Application is entitled only to the filing date of U.S. application No. 10/449,278, now U.S. Pat. No. 6,830,822, of May 30, 2003. Applicant respectfully reminds the examiner that the Subject Application claims the benefit of US '271.

Applicant respectfully submits that US '271 fails to teach or suggest nanomaterials comprising, in part, wherein the nanomaterial has an aspect ratio greater than 5 and less than or equal to 25. The Office Action states that "The nanomaterial has an aspect ratio greater than 1 and up to  $10^6$  (see US '271, col. 9, lines 5-9) which encompasses the claimed aspect ratio of 5-25 (sic)." Office Action, p. 5. According to MPEP § 2131.03

When the prior art discloses a range which touches or overlaps the claimed range, but no specific examples falling within the claimed range are disclosed, a case by case determination must be made as to anticipation. In order to anticipate the claims, the claimed subject matter must be disclosed in the reference with 'sufficient specificity to constitute an anticipation under the statute.' What constitutes a 'sufficient specificity' is fact dependent. If the claims are directed to a narrow range, and the reference teaches a broad range, depending on the other facts of the case, it may be reasonable to conclude that the narrow range is not disclosed with 'sufficient specificity' to constitute an anticipation of the claims. (emphasis added).

The Office Action fails to identify any specific examples of US '271 that disclose nanomaterials having an aspect ratio as required by independent claims 1, 19, and 33. Indeed, Applicant respectfully submits that US '271 provides no specific examples of nanomaterials having an aspect ratio greater than 5 and less than or equal to 25. Applicant respectfully submits that US '271 fails to teach or suggest nanomaterials having an aspect ratio as recited in independent claims 1, 19, and 33 with sufficient specificity. Applicant respectfully submits that the broad range disclosed in US '271 from greater than 1 and up to 1,000,000 is not disclosed with sufficient specificity to anticipate the narrow ranges recited in independent claims 1, 19, and 33. Accordingly, Applicant respectfully submits that US '271 fails to teach or suggest each and every element as set forth in independent claims 1, 19, and 33 and dependent claims 5, 20-23, 28, and 34, which depend, directly or indirectly, from independent claims 1, 19, and 33, respectively, for at least the reasons stated herein.

VII. Claim Rejections under 35 U.S.C. §103(a)

Applicant respectfully submits that a *prima facie* case of obviousness has not been established. According to MPEP § 2142, the examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. The key to supporting any rejection under 35 U.S.C. § 103(a) is the clear articulation of the reason why the claimed invention would have been obvious. As the Supreme Court recently stated,

"rejections on obviousness cannot be sustained with mere *conclusory* statements; instead, *there must be some articulated reasoning* with some rational underpinning to support the legal conclusion of obviousness." *KSR Int'l v. Teleflex Inc.*, 127 S. Ct. 1727, 1741 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (emphasis added)). Applicant respectfully submits that a *prima facie* case of obviousness has not been established because the Office Action fails to clearly articulate the reason(s) why the claimed invention, as amended, would have been obvious. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of non-obviousness. MPEP § 2142.

#### VIII. Status of Related Patent Applications

The examiner's attention is directed to the following pending applications which may contain subject matter related to the subject matter disclosed in the Subject Application.

U.S. application No.	Filing Date	Status Date	Status
11/068,714	March 1, 2005	March 4, 2009	Pending
11/812,550	June 20, 2007	March 4, 2009	Pending

In addition, the Examiner's attention is also directed to the following issued patents which may contain subject matter related to the subject matter disclosed in the Subject Application: U.S. Patent Nos. 7,250,454, 6,830,822, 6,602,595, 6,933,331, 6,513,362, 6,344,271, 6,228,904, 5,905,000, 5,952,040, 5,851,507, and 5,788,738.

#### IX. Conclusion

Accordingly, for at least the reasons set forth above, pending claims are enabled and novel and non-obvious in view of the references cited in the Office Action. Applicant requests favorable reconsideration of the Subject Application and the issuance of a Notice of Allowance.

If the undersigned can be of assistance to the examiner in addressing any additional issues to advance the application to a condition of allowance, please contact the undersigned at the number set forth below.

Please continue to direct all correspondence for this matter to PPG Industries, Inc., Intellectual Property Department, One PPG Place, Pittsburgh, PA 15272.

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